

APPENDIX C

POPULATION EXPOSURE ASSESSMENT FOR SCREEN RECLAMATION PROCESSES: SCREEN PRINTING CTSA

The purpose of a general population exposure assessment is to account for amounts of chemicals with which people who are not directly involved in the screen printing process may be in contact. There are several ways that the general population may be exposed to substances used in the screen reclamation process. People may breathe the air containing vapors which have been carried away by air currents from a screen printing facility. The vapors would be environmental releases stemming from evaporation of products at the screen printing facility. People may drink water which contains residues from the reclamation products, which can originate with the facility discharging the products down the drain. People may also drink well water that contains contaminants which have migrated from a landfill where wastes are disposed. The amount which a person may come in contact with varies with how far away they are located from the facility, how many of the different routes of contact they actually have (such as drinking, breathing, touching), how long the chemical has been in the environment, and how the chemical moves through the environment. The amounts also depend on such environmental conditions as the weather or the amount of water that is flowing in the receiving stream or river where the facility's discharges go.

EPA has published Guidelines for Exposure Assessment in the Federal Register. These are guidelines for the basic terminology and principles by which the Agency is to conduct exposure assessments. There are several important issues relevant to this assessment. If the methodology is one which allows the assessor to in some way quantify the spectrum of exposure, then the assessor should assess typical exposures, as well as high end exposures or bounding exposures. Typical exposures refer to exactly that, how much the typical person is exposed to the particular substance in question. High end refers to a person exposed to amounts higher than 90 percent of the people (or ecological species of interest) exposed to the substance. Bounding estimates are judgments assuming that no one will be exposed to amounts higher than that calculated amount. However, in many cases, all we can do is give a picture of what the exposure would be under a given set of circumstances, without characterizing the probability of these circumstances actually occurring. These are called "What if" scenarios. They do not try to judge where on the exposure scale the estimate actually falls. All of the exposure assessments fall into the "What if" category for this assessment.

The fate of the chemical in the environment is how we refer to the breakdown (transformation) and mobility of the chemical through air, water, and land. There is a different chemical fate for release through a waste water treatment facility as opposed to an air release or a landfill release. There are also different processes by which degradation may occur. For example, in air, a chemical may be broken down by sunlight (by either direct photolysis or photooxidation) or by reaction with water in the atmosphere (hydrolysis). In water and soil, an important degradation process is biodegradation, where the substance may be decomposed by bacteria and other biota in the environment.¹ Each of these processes will have its own rate (speed) at which it occurs, and this may vary with the concentration of the chemical in the system. Often the way we present the fate for a chemical is by giving a half-life value. This term simply means the amount of time it takes for one-half of the substance initially present to be lost by degradation. There are

¹ Note: Hydrolysis and photolysis may also be important depending on the chemical and the environmental compartment.

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other ways to present fate. If we are interested in how much of a chemical is removed from water during its trip through a waste water treatment facility (such as a POTW - Publicly Owned Treatment Work), we will give a removal amount, usually in percent. The Screen Printing CTSA has summaries of the chemical fate of all of the chemicals identified as being used in screen reclamation products.

There are two perspectives to address when handling exposure concerns for any commercial process. The first is best described as a local point of view, i.e., a single facility in normal operation will have certain releases which affect a specific area and specific local population. Since we do not have information for each screen printing facility, we use a "model facility" approach to calculate typical releases and environmental concentrations. This will not allow us to specify the number of people around the facility, because the population varies considerably depending on the location of the screen printing facility. The other perspective is to view the overall impact, i.e., what is the impact of all of the printing facilities for the general population. While one facility may not be releasing very much of any given chemical, the cumulative effect of all of the printers in an area could be serious.

For this assessment, we have tried to present a view of the local concerns by presenting exposures for a standard set of conditions, by which we are trying to simulate a single facility for all of the methods and systems. The overall perspective is presented only for the traditional systems, which are the systems which are considered to already be in common use. It was felt that it would be far too hypothetical to do an overall perspective for the alternative formulations since we do not have a basis for predicting how many screen printers might use any given formulation.

The effects of a chemical may be a short-term (acute) effect, such as the effect a poison would have on the body, or it could be long-term, such as a carcinogen. For long-term (chronic) effects, it is most helpful to have average, or typical, exposures, since the effect will vary with the cumulative exposure. For acute effects, a peak exposure estimate would be more helpful. This can then be compared to levels at which the chemical is known to give immediate health problems. In general for this assessment, average concentrations are calculated.

OVERVIEW BY MEDIA

Air

Releases to air are from evaporation of chemicals during the process. This may be from allowing screens to dry during reclamation, or from rags or open drums of chemicals located around the facility. These vapors are then carried and mixed with outside air. The air concentration will depend on weather conditions. Stagnant conditions will not move vapors away quickly, so local concentrations will be higher than the concentrations of the chemical farther from the plant. There is the potential that everyone outside the facility could be affected. The chemical concentrations will decrease with distance, but the number of people may increase with distance, depending on the location of the screen printing facility. Usually the exposure assessor will use a

computer program to determine the number of people around a known facility by using census data. Since the locations of all the screen printing facilities across the country are not known to us, we use the model facility approach, and do not count population for the model facility.

For our model facility, we assume a building height of three meters, and a width of ten meters. This is a building approximately the size of a garage. We then pick sample weather conditions, usually from San Bernardino, to determine what the air concentration of a chemical will be at a set distance from the printing facility. We use San Bernardino because the weather conditions there will give the highest average concentrations around the facility of any of the approximately 500 weather stations in the United States. However, none of the average concentrations across the country will be even ten times less than the average concentrations at San Bernardino. If the highest concentration were 10 ug/m^3 , then anywhere in the country the concentration would be greater than 1 ug/m^3 . We would say that there is less than an order of magnitude difference.

Methodology References

Air Modeling Parameters for ISCLT90

MODEL - Industrial Source Complex, Long Term: U.S. EPA, Office of Air and Radiation, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, Version 90, as implemented by the Office of Population Prevention and Toxics in the Graphical Exposure Modeling System, GEMS Atmospheric Modeling Subsection.

The following default parameters were used:

- Regulatory default setting for ISCLT;
- Facility location at 34° latitude, 117° longitude;
- The Star Station (meteorological) data from the station closest to the point of release, San Bernardino, CA;
- Urban Mode (U3);
- Standard Polar grid, with 3 calculations per segment;
- Single point of release at the facility location; and
- Release height of 3 meters for fugitive releases from an area source of 10 meters by 10 meters (100 m^2).

Surface Water

Releases to surface water are those releases discharged through a drain at a screen printing facility that end up going to public sewers or POTW. This discharge is treated before being released, and the effectiveness of the treatment determined, so that the amount actually getting through to the receiving water body can be calculated. The receiving water will dilute the discharge from the POTW, and a stream concentration can be calculated using stream flow information.

We use average stream concentrations to calculate average drinking water consumption. We assume that people actually drink the two liters a day that is recommended for good health. If the chemical is one that will accumulate in animals or plants, we calculate ingestion of the chemical from eating fish.

The other issue for surface water is the effect that a chemical may have on aquatic organisms, from algae to fish. If the food chain is broken in a stream, the consequences are dire. No algae, no fish. A healthy stream with numerous organisms will also have a better ability to handle chemical releases than one whose quality is already compromised. The organisms lower on the food chain, such as algae, tend to have shorter lives, making shorter exposure time periods more critical. Since concentrations will vary with the stream flow, there may be periods of lower flow conditions where the same amount released as on a regular flow situation will cause problems. We use historical stream data to try to predict how often this will happen.

Cumulative releases to the same POTW may be estimated by counting the number of screen printers in an area and distributing the releases across all the POTWs in the area. We have to assume that the releases are for the same products, or very similar products. As for air, this cumulative number is expected to be far more significant than the amount for any single screen printer.

Methodology Reference

Single Site

Concentration = Chemical Loading / Streamflow

In general, the concentration will be in ug/L, and the chemical loading is in grams or kilograms. The streamflow used is the harmonic mean streamflow in Million Liters per Day (MLD) for drinking water concerns, if the location is known. Otherwise, the streamflow will be assumed to be 1000 MLD.

US-Wide Water Releases

The methodology used is outlined in its entirety in a report from VERSAR, Inc. For Task I-11, subtask 101, from Contract 68-D3-0013. Copies of this report are available from either VERSAR, Inc. or from Sondra Hollister at EPA.

Septic Systems

There appears to be a significant minority of screen printers who do not release water to a waste water treatment plant. These printers are assumed to release to septic systems. The releases of this type are not modeled in this assessment. There are some general guidelines that may be used to determine if there will be exposure to any of the screen reclamation chemicals from septic system seepage. Each chemical will have an estimated potential migration to ground water, which is usually used for landfill assessments. This can be directly applied to septic systems, because the potential to migrate to ground water will be the same. Of course the

individual characteristics of the system will determine the actual speed that each chemical travels into the ground water. If the septic system is relatively leaky, and the ground water table is relatively high, the time that a chemical takes to get into the ground water will be shorter than for a septic system which is sealed well and where the ground water table is low.

Landfill

Our usual techniques for estimating exposures from landfill releases are not applicable to printing. For a typical situation, we would assume one facility sending waste to a landfill. For the printing industry, the use of landfills cannot be so simplified. A lack of data limits the determination of exposures. We do not know how many printers are sending a portion of their wastes to a hazardous waste handler, and sending another portion to the county landfill, or how many printers will be sending to any given landfill. For these reasons, even though the exposures from landfill releases may be significant, we will not be able to calculate exposures from landfill seepage and migration into ground water. However, we can give the expected fate of the chemical in the landfill -- will the chemical migrate to ground water rapidly, moderately, or negligibly.

